INTRODUCTION

ACME, Advance Computer for MEdical Research, is about to conclude its sixth year as a research, development, and service facility. One year ago, a fifteen month administrative extension was requested to become effective August 1, 1972. After discussion with NIH, our fifteen month extension request was reduced to twelve months.

This annual report describes the accomplishments of the past year and proposes a new work program for the fiscal year 1973. We expect this to be the final year of NIH support for ACME under this grant. A new competing proposal has been submitted separately for the creation of a new research resource at Stanford. The primary task to be accomplished under the last year of the ACME grant is preparation for the transition to a service facility whose operating costs, hopefully, will be totally recovered from user fees.

During the past several months, a number of faculty members have contributed actively to long term computer planning for the Medical Center. One question still under review is a proposed merger of an academic service-computing facility such as ACME with the Hospital Data Processing facility. A parallel but separate planning effort is embodied in a proposal for "SUMEX" (Stanford University Medical Experimentation Computer Facility), a new research resource for computer-science research on bio-medical problems. At the university level, planning has dealt with the interrelationships among Medical Center, university administration, and all other campus computing. A brief description of several of these planning activities is incorporated in this report.

I. SUMMARY

A. Highlights of Fiscal Year, 1972

The most significant accomplishment of the past fiscal year has been the active involvement of the faculty and technical staff in planning the future of computing at the Stanford Medical Center. Although the long range-plans have not been completed, considerable progress has been made, resulting in a far better understanding of our current and future needs.

The long-term viability of ACME, viewed as a service facility for the Medical Center, is tied to its ability to earn income sufficient to cover cost. In mid-April, 1972, a new rate schedule became effective for ACME users. Monthly income in the last three months of this fiscal year, is expected to reach an average of $40,000. This figure includes both computer service income, which reverts to the grant budget, and terminal service income, which is handled outside of the ACME grant. Several major users have developed new systems on ACME which will be moved to dedicated standalone systems in production mode. As soon as these dedicated systems are available, income from these sources will drop. On the other hand, one can expect that new applications will continue to be developed which in turn will generate new income.

Service on the ACME facility has been markedly improved in the past fiscal year by the installation of new hardware and software. New hardware includes faster bulk core, a small machine interface capable of handling up to 16 satellites, faster access disk drives, an initial complement for the small machine equipment pool, a terminal controller that will support multiple terminal speeds, and new graphics hardware. Software improvements include improvements to the realtime system, extended graphics support, improved text editing, additional terminal support, improved small machine support, file support, and compiler improvements.

Several new and interesting user projects were implemented during the past year. Some of the more interesting new projects include Dr. Green's activity in Biological Science, Dr. Kadis in Anethesia, Dr. Tatton in Biological Science, Dr. Lawrence William in Oncology, and Dr. Jerome Gold in Diagnostic Radiology. These projects are described in the project descriptions in Section VII.

Continuing user projects include the DENDRAL project, which has connected a new Varian mass-spectrometer to the ACME system and has used the General Purpose Graphics Terminals (developed by Dr. Shipton at University of Iowa) to actively support spectrometer operations. Also, Dr. Stanley Cohen's drug interaction project has received considerable program assistance during the past year. His project, formerly part of ACME's core research activity, received independent funding in November of 1971. A close cooperation between ACME and the drug interaction project continues. Dr. James Fries in Immunology has continued to develop his time-oriented medical record concept. His system has received good acceptance among physicians in the rheumatic clinics and is being actively considered for implementation by other departments (Oncology, Cardiology, and Hematology). The Oncology Department has recently started data entry under programs designed to use the time-oriented medical record.

Utilization of ACME has risen only slightly during the past year. However, this is considered highly satisfactory since the amount of subsidized usage has decreased markedly while the amount of paid usage has increased. Also, since the basic service charge is measured as pages of occupied core times minutes used, installation of a faster core box necessarily resulted in more computing accomplished in a fewer number of pageminutes.

B. Goals for Fiscal Year, 1973

A summary listing of objectives for fiscal year 1973 are presented below:

1. Determine a list of new services required under ACME to assist in improvement of the income posture; Then freeze the system after essential changes are made.

2. Identify critical planning areas for mounting an interactive PL language on the proposed SUMEX System (a DEC PDP-10). Improve the documentation of the ACME system in those areas that will be required to assist in the transition.

3. Actively support the activities of the Stanford Medical Center Computer Planning Committee.

4. Improve small machine support, especially by assisting users in taking advantage of the new small machine multiplexor.

5. Provide batch services to better utilize the night shift hours.

6. Assist in coordination of a project to generalize programs for the time-oriented medical records system so that multiple departments can share in its use.

7. Select commercially available hardware to replace existing terminals and other peripheral units when performance improvements can be realized at cost effective prices. Attempt to make the use of ACME more cost effective wherever possible.

8. Explore the offering of PL/ACME services to potential users at other institutions through commerical communications systems such as TYMNET. Operational ramifications that might result from such an offering will be discussed with Biotechnology Resources Branch.

In summary these objectives call for provision of new services that will attract added income, the freeze and documentation of the existing system, the release of staff time to work on transitions to future systems, and for attracting and assisting new users.

C. Comment on Medical Center Computer Planning

The Stanford Medical Center consists of the Medical School, Hospital, and Out-Patient Clinics. Computing within the Medical School is handled primarily by the ACME facility plus a number of dedicated standalone systems, some of which are connected to ACME. Hospital computing is handled by an administrative data processing facility operating an IBM 360/40. The bulk of the out-patient clinic computing is currently handled by the University Administrative Data Processing Facility on an IBM 370/145. This distribution of the computing load has not proven satisfactory to the user community. A number of alternatives are being explored.

The role of ACME during the past three years has been to provide computing services to faculty and staff researchers in the Medical Center. Earlier the role of ACME was to develop new techniques for offering such services. As the number of users has grown, demand has increased for highly reliable, stable, and available service. For this reason the development effort of the ACME facility has shifted to extensions and improvements to existing facilities rather than radical

changes which would severely impact availability of routine service computing. To provide a research system which can tackle problems associated with high data rate realtime research is the subject of a separate proposal recently submitted. This proposal calls for the creation of a dual processor facility in which one processor and its peripherals are dedicated to providing service to the medical community, while the second processor will be dedicated to a small number of research groups.

The organization of the planning effort, current status, and a brief discussion of some of the alternatives under consideration are briefly described in Section II.

D. Overview of Six-Year ACME Experiment

In the past six years, the NIH-sponsored ACME experiment has accomplished the following:

1. A computing system that is remarkably easy to learn and to use has been designed and built.

2. More than 230 user projects, exclusive of ACME staff, are current users of the system.

3. The system provides a highly interactive time-sharing service and realtime data acquisition. The data collection capabilities are limited to data rates which, in light of current technology, appear slow and limited. Problems of closed loop applications have not been satisfactorily resolved using the 360/50, primarily due to its architecture and other inherent limitations.

4. More than 500 MD's have been trained in the use of this system. Many MD's performing research at Stanford now do their own programming at an ACME terminal.

5. Small machine support from ACME is limited but growing.

We have learned in the past six years that computer science-type research which can involve frequent hardware adjustments and changes, as well as systems software changes, cannot be performed effectively on a resource which routinely provides service for the balance of the community. Conflicts over resource allocation between research oriented as opposed to service oriented users lead to compromises unacceptable to one or both groups.

The rapid advance of small machines was not anticipated at the time of the original ACME proposal. This mini revolution has provided faster, better, more economical systems, including broader peripheral support, than we envisioned in 1965-66. We continue to see a role, at least for the next three to five years, for the large central processor, assuming that its resources are supplemented with a number of satellite computing systems to handle special requirements.

A problem which we have been unable to resolve is how to provide free computing to pilot projects around the Medical Center. We've observed that a number of the pioneering computer efforts have been possible only by viture of the free computing provided under the ACME grant. As the need to provide self-sufficiency increased, we were able to approve fewer new pilot projects each year. We strongly urge that NIH waive one of its policy restrictions for the coming fiscal year,so that ACME can continue to encourage the development of new concepts on a pilot basis through non-chargeable computing services. The University in turn must determine some method of funding such usage when there is no longer an ACME grant behind the service system.

Computer users nationwide are learning that the software costs (both systems and applications) far exceed the hardware costs in most installations. The significant investment forces consideration of major transition costs when converting to new hardware or software systems. We have learned that we would like to use manufacturer's supported software whenever possible to provide maximum exportability to other institutions. We also observe a trend in which software will become an increasing percentage of the total computing picture. Therefore, we would like to see more integration of resources within the Medical Center so that personnel need not be trained on multiple hardware and software systems, and they will not be required to reprogram their efforts.

II. STANFORD MEDICAL CENTER COMPUTING PLANS

A. The Medical Center Scene

During the past fiscal year, Dr. Clayton Rich, was appointed Dean of the Medical School. He has expressed concern for the long-range planning of computing in the Medical Center. Recently, a new faculty position was created in the Department of Community Medicine for appointing an M.D. with a strong interest in problems associated with service computing in a medical environment. In January, 1972, Dean Rich established a Medical Center Computer Facilities Planning Committee and charged it with the responsibility of examining the feasibility of merging the ACME facility with the Hospital Data Processing facility. To date, the Committee has spent the bulk of its effort examining alternative organizations and configurations and identifying service requirements. Hopefully, by early fall, the Committee will be prepared to recommend specific actions to the Dean. ACME staff members will provide technical support to the Committee's deliberations.

B. ACME Follow-on Grant

The SUMEX proposal calls for creating a high data-oriented resource using a PDP-10 as the host computer. Dr. Lederberg, who is Principal Investigator of the new proposal, has suggested that the service system for the Medical Center be a hardware configuration similar to the research system. In this way, developments occurring on the research system can be moved readily to the service system. It also provides a strong back-up capability for the service system. One thing learned at ACME is that Medical Center personnel place a high value on reliability and availability. Only by having a back-up system can the kinds of requirements frequently cited here be met.

The impact of the proposed research system on ACME's plans for the coming year is reflected in the decision to freeze the ACME system design as soon as possible, tie together the loose ends through documentation, and move on to efforts that will smooth the transition to another hardware system. Other demonstrations of the impact on our planning are as follows:

1. The current staff will require training on PDP-10 hardware and software systems.

2. Planning which in the past has been based upon IBM hardware selection will have to be modified.

3. Increasing the income of the service facility requires development of more usage and more users. The creation of a new research facility will dilute the funding base to some extent.

4. A consensus must be reached concerning the long range plans for the Medical Center so that users of the existing ACME facility will not be motivated to develop dedicated stand-alone systems for all applications. The Dean of the Medical School will be expected to make some firm commitments in order to avoid confusion and uncertainity over the existence of a large service center.

III. ACME FACILITY ACCOMPLISHMENTS, 1972

Accomplishments by staff Operations, Systems, and Applications groups and efforts supporting Medical Center planning are described. User core research progress notes are included in the section entitled 'Project Descriptions'.

Last year's report indicated that two factors were shaping changes in ACME. The first was financial and the second involved a choice between serving special research versus general computer users. Efforts to solve the financial problem necessitated the substitution of faster bulk core, which increased our capacity significantly while only slightly increasing costs. By adding capacity we have been able to offer services to more users within the Stanford medical community. In addition, rate adjustments have been announced which will help us determine the viability of ACME in a market situation where prices are set close to actual cost of providing service.

A. Planning Studies

1. ACME/Campus Merger Study

Last fall, a study was conducted to determine the feasibility of merging ACME with the Stanford Campus Facility. The study focused on (1) the capacity of the Campus 360/67 to absorb the ACME load; (2) an overview of service and cost considerations; (3) a review of planned changes within the Campus Facility; and (4) the relative advantages and disadvantages of a merger. A number of problems were identified which resulted in further consideration of merging Hospital and ACME computing facilities rather than Campus and ACME facilities. Some notes on the ACME/Campus merger study were issued in the form of a technical note, ACM, a copy of which is enclosed as Appendix A.

2. Comparision of Available Time-Sharing Systems

The IBM systems TSO, CPS, and CALL-OS are under review as to their possible application to Stanford medical computing. Some specific questions to be answered are the language differences between the various PL/I subsets, the magnitude of the conversion problem from PL/ACME to another PL/I dialect, hardware requirements for approximately 50 terminals, and some of the specific pros and cons associated with each system.

3. Alternative Hardware Proposals

Gio Weiderhold, Tom Rindfleisch and Chuck Dickens were asked to suggest a limited number of feasible hardware configurations for consideration by the Medical Center Computer Facilities Planning Committee. The purpose of this request was to limit the amount of decision space to be actively considered. The seven alternatives suggested by the subcommittee included a large IBM processor, a dual IBM configuration, a large DEC processor with satellite systems, a highly distributed computing system, finally the purchase of essentially all services from outside sources. The MCCFPC has rejected four of the seven alternatives and continues to study the remaining three. The new proposal, recently submitted by J. Lederberg, calls for a dual PDP-10 configuration in which one machine is primarily a research support machine and the second machine is a service system.

There has not been adequate time to date for detailed review of this topology by the MCCFPC. One of the more significant problems envisioned with this topology is the existence of a large number of second generation programs currently operating on IBM hardware supported under DOS. Even if these programs were converted to COBOL, it is not clear that the Hospital would choose to run on hardware other than IBM. However, a fairly small IBM machine might absorb the load, while coupled to the patient data base and to a PDP-10. Clearly the MCCFPC has some difficult problems to resolve over the next several months.

4. Small Machine Support Study

The ACME systems staff, in cooperation with staff members of other SCC facilities, formalized current ideas on the types of services required of a large host computer to adequately support a variety of satellite machines. A summary of the study was published as ACME Technical Note PSCS and is included as Appendix E. A few of the salient features are a 'front-end' networking switch, continuous spooling service, the capability of the satellite computer to act as a master terminal, and high level language processors.

B. New and Continuing Application Programs

1. DENDRAL

The ACME facility attempted to support the DENDRAL project in a number of ways during the past fiscal year. One approach at supporting DENDRAL has failed. An interactive LISP compiler was mounted under PL/ACME. Although the compiler runs and can be used, it is too slow for the large programs which the DENDRAL project tend to execute. Furthermore, the compiler is not identical to the batch version which imposes limitations on the user. More successful have been the efforts to support with hardware and software the 315C General Purpose Graphics Terminals. Using the tools provided, DENDRAL programmers have written a rather complete set of operator aids using a GPGT. In addition, a remote job entry system for overnight batch jobs has been partially prepared during the month of May. It is hoped that this service will be offered routinely in June, and that it will subsequently be improved to be more flexible in general. Limited assistance was provided in planning the long-term needs of the DENDRAL project for computing. Finally, the DENDRAL staff has been very helpful to ACME in identifying and solving realtime support problems.

2. Drug Interaction Project

The data entry and label printing program was placed into production in the Hospital Pharmacy last September. Two CRT devices and two printers are used for entering perscription information into a central patient file and for subsequent perscription label printing.

The second phase of the project will implement automatic drug interaction searches and reporting of detected interactions to the physician. Incorporation of interaction searches into the production pharmacy system is imminent.

3. Oncology Time-Oriented Records

Members of the ACME staff have applied the concept of Dr. James Fries' time-oriented medical records to computerization of the Department of Oncology patient files. Both narrative and numerical data are collected and presented in a three-dimensional form (patient, medical measurements, and time).

Initially, four programs have been developed. A patient record input program allows for item entry in either a serial manner or in an operator-determined sequence. A second program automates specific item editing on the file. The third and fourth programs generate letters to referring physicians, describing the current status of each patient's diagnosis as determined by the time-dependent visits to the Oncology Clinic.

Ultimately, we plan to incorporate the data bank analysis programs of Dr. Fries into this project.

4. New Realtime Projects

Several new realtime users joined us last year. William Tatton, Stanford Department of Biological Sciences (P. I., Donald Perkel) is engaged in a study of the characteristics of neural circuits underlying behavior and sensory information processing in both mammal and invertebrate nervous systems. Dr. Paul Green, also of the Department of Biological Sciences, is analyzing the growth process of plants. Growth rate is measured as a function of step shifts in the turgor pressure. The system is a model for the study of mechanisms for cessation of growth in man.

Doctors Walton Roth and Leslie Kadis are both studying EEG data, but for differing purposes. Dr. Kadis, Department of Anethesia, was awarded a pilot project for a psycho-physiological study of tolerance to experimental pain. Normal college-age students are subjects for collection of data relevant to an individual's pain threshold, response to drugs, etc. Dr. Roth of the Palo Alto Veterans Administration Hospital, Dept. of Psychiatry, is processing EEG data for statistical analysis of measures derived from special purpose machines.

5. CSMP Design Study

A design specification for inclusion of an interactive Continuous System Modelling Program (CSMP) in the ACME system has been published as ACME Technical Note CSMPI. Model definition is accomplished by standard CSMP language statements with PL/ACME statements intermixed in the program. Processing is in three stages: (1) translation of the CSMP model to a PL/ACME program equivalent, (2) compilation of the PL/ACME program, and (3) execution. Plans for implementation are in abeyance at this time.

6. Radiation Therapy Programs

An information retrieval program was written for the Radiation Therapy Department. The data base contains information on cancer patients and on the results of various types of treatment. The information had been collected by the Department over a 3-year period. The program prints selected patient information as determined by the interrogating radiologist.

7. Application Programs for Public Use

Several new programs were included in the ACME Public Library. These include a routine employing the Cooley-Tukey Fast Fourier Transform Algorithm and AZTEC, a program for reducing a sequence of observation samples to a list of horizontal and inclined straight line segments.

A PL/ACME to PL/I (F-level) translator was written. Most conversions are performed automatically, but manual recoding is still required for conversion of many input and output statements.

Program PLOTPRIN produces plots on the printer or user's terminal. The PL/ACME version of the OPS package is used to generate the plots. Other programs include a data file copying routine, an empty file deletion program, and a program to print an alphabetized listing of a project catalog.

C. System Software Improvements

1. Extended Graphics Support

The Stanford Computation Center Campus Facility OPS (Overall Plotting System) graphics package was adapted to PL/ACME last year. OPS allows the user to plot an entire graph by simple calls for grid, grid labels, titles and plotted data. Any one of ACME's various plotting devices may be specified as the destination of the plot.

Software support was included in the 1800 system for support of the 315C General Purpose Graphics Display Terminal. Both character mode for display of text information and the usual graphics mode (where text may be 'drawn') are provided. In character mode, line and column control is provided. Modes may be intermixed within any PL/ACME program.

The Calcomp plotting package was revised in a very minor manner which surprisingly produced a 20% decrease in execution time. The change was based upon a known FORTRAN deficiency in compiling code for symbolic array subscripts.

2. Additional Realtime Improvements

Four projects are to be cited. Additionally, data rates to and from the 1800/360 were increased by approximately 15% with the installation of the AMPEX bulk core memory. Additional increases in the 1800 data transfer rate do not appear possible due to the limitations of the IBM 1800 hardware.

The 1800 disk management routine was redesigned so that realtime data collected on the disk is not lost as a result of a failure of the 1800 system.

A PL/ACME function EVENT was added to the language syntax. This function allows the user to detect the occurrence of a data transfer into the 360 and to issue a read command only after the transfer has completed. The benefits include simultaneous processing while waiting on a realtime occurrence and the ability of a program to respond dynamically to several realtime input devices. The function has been implemented successfully for both 1800 applications and for the Drug Interaction Project via the PDP-11.

Operator permission to use realtime lines was eliminated. Programmed use of devices routed through the PDP-11 require no operator permission. A PL/ACME function allows the 1800 user to enable himself (the PERMIT18 function). The operator is informed of 1800 status via operator console messages and via the SHOW DSOPEN command. He may disallow further use of realtime lines when data rates for all lines reach the physical maximum.

ACME system control is based upon a two-level priority scheme. The highest level is allocated to the 1800 realtime user. Changes were incorporated so that the duration of time for any realtime user on the high level priority queue is dynamically variable.

3. Improved Text Editing

ACME's text editing package was enhanced by the addition of the LIST and CHANGE commands. LIST outputs lines on the terminal; CHANGE modifies lines of text without the requirement of user verification. In both cases, one may edit according to a specified line range or context criteria. Terminal output may be suppressed completely or limited to text only or line numbers only. A by-product of this project was general improvements to the code for the MODIFY and DELETE commands. A portion of the Text Editor was written in Assembler Language to facilitate rapid execution.

4. Additional Terminal Support

Concomitant with the installation of the Memorex 1270 Terminal Control Unit, software additions recognize a terminal type and invoke the necessary supporting software. 2741 correspondence code terminals are more easily specified at logon time. ASA standard terminals are supported for both display and typewriter devices and from all TCU ports.

5. Satellite Machine Support

Two major efforts for the support of satellite computers are noteworthy.

Stanford Computation Center Engineering Services has completed the design of a satellite computer multiplexor interface to one of our 2701 ports. Supporting software has been implemented for the ACME system and for PDP-11 satellites.

The ACME software resembles the current 1800/PDP-11 support in many ways. The user interface is nearly identical. All communications is asynchronously interrupt driven. Differences in the supporting software do exist, primarily because of protocol destinctions and because of an effort to learn from the 1800/PDP-11 software implementation.

The SM multiplexor software is in the middle stage of debugging. We expect to have the project completed by midsummer.

A program to simulate the PDP-11 is available for batch operation and is in the debugging phase for ACME time-sharing execution. The Simulator executes in single instruction step mode. Diagnostic information is returned after the execution of each instruction of a PDP-11 program. The Simulator provides the debugging capabilities of the PDP-11 front panel as well as the capability to initiate the functions of DEC's ODT debugging package. A core loader and a core dump routine are also provided.

6. LISP Additions

Last summer, we added some 32 mathematical and logical functions to the interactive LISP compiler. This was accomplished by interfacing LISP to the corresponding PL/ACME functions.

A version of LISP for batch execution, identical to the SCC 360/67 LISP, has been mounted on ACME. As of preparation of this report, the LISP user has a limited method for submitting OS JCL and ACME files for overnight batch LISP execution. Further efforts on OS RJE submission from ACME are planned for next year. Upon completion, a batch LISP job may be more conveniently specified and the results more easily retrieved at a terminal.

7. File Support Improvements

Several additions to File System support were implemented in the past year. The primary additions are a data compaction algorithm for reducing disk storage space requirements and several new catalog management functions.

The characteristics of numeric and character-type data collected by a program and subsequently stored on disk indicate that considerable file storage could be saved with some simple data compaction algorithms. A study in February, 1972 of existing numeric data is summarized in Appendix C. Storage savings up to 50% are realizable, depending upon the compaction option's degree of use by the user community. System design has been completed. Implementation will begin soon.

Batch execution of requests to move user files to and from tape and disk was partially automated by the inclusion of public and operator programs for generation of OS job requests. On the overnight operations shift, the operator starts an OS reader task which reads the job requests from the reserved disk data set and sends the jobs into the OS job queue. Two specialized utility routines were written for maintenance of the job request data set.

Further plans for an ACME RJE interface will automate this service completely by eliminating any need for operator intervention. Job requests submitted from a terminal will be routed directly to a spooled job queue.

Other improvements include two PL/ACME functions, BLOCKS and TYPE, for determining assigned disk block space and the storage mode of a file (data or text) respectively, the extension of the PROTECT statement to prevent a DELETE on a file, and the new SAVE FILE command. SAVE is similar to CLOSE in that index and data core buffers are written to disk, but a subsequent OPEN is not required for continued use of a file. SAVE is a guarantee against loss of data in the event of a system crash.

8. Accounting Software

Software accounting changes included modifications for the new charging structure, the addition of time-slices accounting to the system control program, and the inclusion of charges for printing and punching services. Also, disk file accounting was removed from the weekly Analyzer program and a new, high-speed file accounting routine written for rapid collection of file use charges.

9. PL/ACME Compiler Improvements

The addition of Variable Array Allocation to the PL/ACME language extends its flexibility and cost savings features. Previously, allocation of large arrays were under dynamic control, but the size of the array was explicitly declared at compile time. Now, array size definition may be deferred until execution time. Furthermore, array size (and the core requirement of an array) may vary dynamically during a single execution of a PL/ACME program.

10. Deferred Projects

Last year we reported on two system projects whose implementation has since been suspended. The ACME to OS file conversion project was suspended due to some design deficiencies and the lack of staff personnel. A design specification has been completed which builds on the previous effort, but increases the flexibility of the anticipated service. Full implementation is expected in the near future.

Extended logon, wherein a user session is controllable from a device other than one routed through the IBM 2702 (now Memorex 1270) was suspended when unforeseen design problems were encountered in the ACME system. This project, its desirability, and plans for system modifications to accommodate it are further discussed in Section IV.

D. Hardware Changes

1. Ampex Bulk Core

AMPEX bulk core has replaced 2 megabytes of IBM bulk core. The Ampex equipment has a cycle time of 2.5 microseconds versus the 8 microsecond IBM core. Responses of the ACME system improved considerably following the installation in November 1971.

Core timing studies, conducted during installation of the AMPEX core, are reported in Technical Note WCTR (See Appendix B). Execution time of sample PL/ACME programs improved from 18% to 59% with an average improvement of 36.5%.

2. AMPEX Disk Drives

AMPEX DM312 disk drives (17 spindles) replaced the IBM 2314 disk drives in December 1971. The primary improvement here is an average head seek time of 32 milliseconds as opposed to 60 for the IBM drives. The drives were leased as a part of the contract for the AMPEX bulk core.

3. Memorex 1270

Automatic terminal typing and speed recognition became possible when the IBM 2702 transmission Control Unit was replaced with the Memorex 1270 Terminal Control Unit. Devices other than a 2741 terminal or Teletype typewriter are easily supported up to speeds of 1200 bps. Furthermore, TCU ports no longer need be dedicated to a specific terminal type. Any TCU port may recognize and service any terminal, whether typewriter, display, or computer. ACME views this hardware modification as a major marketing and user service attribute. We intend to exploit its potential wherever necessary and possible.

4. Development PDP-11 System

In last year's report, a small machine equipment pool was proposed. A development PDP-11 system has been acquired through purchase on a second-hand basis. This system includes 8k of core, a printer, a card reader, a fixed-head disk, and an expansion box. The system is being shared by a number of ACME users and is also serving as a test vehicle for small machine support development by the ACME staff.

5. Satellite Computer Multiplexor

This is a specialized hardware interface whose purpose is to allow shared access to the ACME system via one of our 2701 TCU parallel data adaptor ports. The multiplexor was especially designed and built by the Stanford Computation Center Engineering Group for the ACME Facility.

The design is such that 16 satellite computers share a single 2701 port on a block-multiplexed basis. One computer controls the communications interface from start to completion of transfer of a data block. At block transfer completion, control of the interface yields to the next computer if necessary. Data rates up to 250 KB can be sustained. Several designed-in safety features insure that neither the multiplexor nor the the satellite computer can disable the ACME system. Rigid adherence to a communications protocol and a set of hardware timeout functions are the primary guarantees.

6. General Purpose Graphics Terminals

Two 315C General Purpose Graphics Terminals were received in May 1971 from Dr. Harold Shipton and made available to users in the fall of 1971. The displays are now in use by the Department of Genetics and by Abraham Silvers of the Department of Medicine.

On April 3, 1972, the Stanford Medical Center hosted a conference on user experience and reaction to the 315C terminal. The conference was initiated by Dr. Shipton and attended by representatives of eight universities. The general impression was that the conference was informative and successful.

An evaluation of Stanford's application of the GPGT is forthcoming to NIH.

7. 2741 Terminal Replacement Study

Several weeks ago a survey was instituted of available CRT and hardcopy terminals. We are especially interested in 30 and 120 cps terminals now supportable by the Memorex 1270 Control Unit. Several demonstration terminals have been tested by the staff. Some are acceptable, others not.

We expect to purchase several representative terminals from this year's grant funds and from requested funds for next year.

Alphanumeric displays have been used during the past year as realtime devices by the Drug Interaction Project. However, the bulk of ACME users have not had access to CRT terminals primarily due to the speed limitation of 15 characters per second. Wider exposure is now possible (and desirable) with the installation of the Memorex unit.

8. Tape Cassette Study

Last year we indicated that we intended to explore the use of tape cassette attachments for storage of user data. A survey was conducted of cassette units currently available. The conclusion was that no unit performed reliably enough to recommend its use as a storage backup medium. Consequently, other alternatives are under consideration.

9. Planned Acquisitions This Year

Funds remaining in the current budget for hardware acquisitions will be used for purchase of three items:

a. A dual DEC tape transport and controller. We wish to provide DEC tape on our front-end PDP-11 as a convenient and inexpensive method of removing user files from disk when the files need not be continuously on-line.

b. One or two 30 character per second thermographic type terminals. Under consideration are the Anderson-Jacobson 630 and the Execuport 300.

c. Additional acoustic couplers and modems for the higher speed terminals and remote user installations.

E. Operations Report

1. System Reliability

The Mean time between failure fell last year primarily because of the higher than normal system instability during the installation of AMPEX equipment. A chart in Appendix D, comcomparing monthly MTBF for the past three years, shows the pattern vividly. The first of the AMPEX core modules was delivered in November; the last of the AMPEX disk drives were installed in January. By the end of February, the new equipment was stabilized and the MTBF rose dramatically.

Nonetheless, the system failure rate for the year from all causes is slightly better than last year's record. This would indicate that failures due to non-hardware system components are rare, and that the ACME system software is extremely stable.

A chart, summarizing MTBF rates in hours for the past three years follows.

MTBF (System Crashes)	FY70	1 FY71	2 FY71	3 FY72
Hardware caused	64.3	246.6	214.8	147.7
All reasons	34.4	84.8	80.7	82.2

1 Projected figures reported in last year's report.

2 Actual MTBF for the entire year of 1971.

3 Projected totals for 1972. Average of MTBF for AUG71-APR72 determined estimates for MAY72-JULY72.

2. Hours Change

ACME service hours were changed to 7:00am-5:30pm and 11:00pm, daily and weekends. The effects of the modification were to delay the late afternoon system programmer block by one-half hour (from 5:00 to 5:30) and to extend the late evening service period by one hour (from 10:00 to 11:00).

3. Utitity Services

Printing and punching services, performed routinely by operations for the benefit of the user community, are now chargeable under the new rate structure. Statistics on quantities of lines printed/cards punched show that the number of printed lines in March, 1972, was 50% greater than the figure for August, 1971. The demand for punching service has remained relatively low. Of the total printing load in the August to March period (3,575 * 1000 lines), fully 87% is rechargeable.

F. Education and Training

1. PL/ACME Classes

During the 12 months ending April 30, 1972, ACME provided formal instruction to 182 persons. Of these, 164 were enrolled in the PL/ACME introductory course and 18 in the advanced programming course. The format of the courses was changed from three to four sessions each lasting one and one-half hours.

A questionnaire was used during the past several months to obtain data on introductory class participants. A total of 49 questionnaires have been collected to date. The limited sample indicates that:

a. Eighteen of the 49 or 37% expressed specific interest in realtime applications.

b. Roughly 50% are staff employees, the remainder are faculty and students.

c. About one-half are from the Medical School, 25% from the Hospital, and 25% from other departments.

d. Fifteen percent report the PL/ACME course was taken for use in a new project.

e. Thirty-five percent have a Ph.D. or M.D.

2. Medical Computing Seminars

A seminar series was organized to encourage the dissemination of information on biomedical computing in the Stanford community. The first seminar included a talk by Dr. James Fries, Department of Immunology, on his Time-Oriented Medical Records project, and a film depicting the patient-oriented medical records system developed by Dr. Larry Weed.

For the second seminar, George Swanson of Anesthesia described his research activity involving studies of the esophagus. Dr. Howard Sussman and his staff presented the new Clinical Laboratory Information System in the third seminar. Approximately fifty people attended each session. ACME will continue to serve as coordinator for this seminar series.

3. Consulting

Last summer, the consultant's office was moved from the ACME office area to a partition in the machine room. The move was designed to permit greater accessability of the consultant to the user community. In January, the systems staff joined the regular consulting staff in manning the consultant's office. Guaranteed consulting hours are 9:30-11:30 and 1:30-3:30 daily. Each systems staff member is assigned one two-hour block weekly.

4. Staff Training

Several members of the staff have or are scheduled to attend IBM and DEC education classes this year. Chargeable classes, covered by the ACME grant are:

Ying Lew:	DEC: PDP-11 School
Charles Granieri:	IBM: TP Systems Control for Programmers
Stu Miller:	IBM: Advanced Coding
Lee Hundley:	IBM: Project Management
Regina Frey:	IBM: Project Management.

IV. PLANNED PROGRAM FOR FY1973

A. Objectives

The upcoming year will be a period of transition. The Medical Center Computing Facilities Planning Committee will define and establish the nature of computing at the Stanford Medical Center. Assuming that the grant proposal for the SUMEX Computer Facility is approved by NIH, we will begin preliminary efforts on system design, equipment specification, and training. Specific actions are necessary for stabilizing the current ACME system and for increasing the level of self-sufficiency of the ACME Facility.

It must be assumed that the ACME system, as currently constituted, will continue to exist after July 31, 1973 until such time as a blend of the SUMEX Grant, Medical Center computing plans, and Stanford-wide computing produces a viable alternative. The trends of use in the past year show that the majority of users depend upon the ACME system as a routine laboratory tool for solution of their own research problems. We expect this dependence upon ACME for service computing to continue.

B. Applications Development

1. Digital Filtering Program

We have contracted with Professor William Gersch of the University of Hawaii for a summer project on development of several digital filtering, spectral analysis, and time series analysis programs. They will be designed for application to to ACME realtime user problems and will be publicly available. The availability of these programs will be an asset to the system, as some of the techniques to be employed have not, to our knowledge, been attempted elsewhere.

2. Installation of Voice Drum

The voice drum will be interfaced to the production PDP-11 system this summer. The initial application of this device will entail retrieval of limited patient data for the Division of Oncology. Residents and others will be able to access limited patient data via touch-tone telephones from throughout the Medical Center or from their homes. This project involving the Oncology Division is in the early planning stage at this time. (See further notes in Hardware and System Software Sections.)

3. Stroke Registry Programs

The Stroke Registry Program began over two years ago, sponsored by the California Regional Medical Program. The goal of the program is to develop a population base for analysis of descriptive parameters of stroke and to produce predictive output for the improvement of care and treatment of patients.

At this time, first year followup data on surviving patients is being collected. A member of the staff will develop programs for entry of followup data and for correlation analysis.

4. Critical Path Analysis

A publicly available computer program for critical path analysis of a class of multi-segment resource scheduling problems is scheduled for implementation soon.

inistration to medical
g resources. The administra-
ct would benefit greatly from

rom the Stanford Linear
e to PL/ACME.

written the well-known
on text data. This program
ort algorithms examined,
ritten for the Public Library.

Center management, from general adm
programs and management of computin
tion of any externally funded proje
such a program.

A FORTRAN program, available f
Accelerator Center, may be adaptabl

5. Fast Sort for Text Data

A member of the ACME staff has
SHELL sort algorithm for operation
will be reviewed, other published s
and a generalized PL/ACME program w